Effectiveness Of Telerehabilitation With Surface Electromyography On Muscle Function And Quality Of Life In Robot-assisted Total Knee Arthroplasty Individuals.

SHORT SYNOPSIS

Submitted in partial fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

To

Manav Rachna International Institute of Research and Studies(Deemed to be University)

by

Dheeraj Kumar
22-23/Ph.D/W/002

Under the supervision of

Supervisor
(Dr.) Jasmine Kaur Chawla
Associate Professor,

Department of Physiotherapy
School of Allied Health Science,
MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIESSECTOR-43, SURAJKUND –DELHI ROAD, FARIDABAD – 121004

SCHOOL OF ALLIED HEALTH SCIENCE

Certificate

I hereby declare that the short synopsis "Effectiveness of Telerehabilitation with Surface Electromyography on Muscle Function and Quality of Life in Robot-assisted Total Knee Arthroplasty Individuals" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Physiotherapy under School of Allied Health Science of Manav Rachna International Institute of Research & Studies, Faridabad during the academic year 2024. It is a bona fide record of original work carried out under the supervision of Dr. Jasmine Kaur Chawla and has not been submitted in full or part to any other university or institute for degree or diploma. Further, it is certified that short synopsis is plagiarism free and proof has been submitted.

(DHEERAJ KUMAR)
22-23/Ph.D/W/002

Signature of the Supervisor
Dr. Jasmine Kaur Chawla,
Associate Professor, SAHS

(Chairman, DRC)

(Dean, School of Allied Health Science)

ABSTRACT

Introduction: Total knee arthroplasty (TKA) is the well-known solution for chronic degenerative and post traumatic cases. Although conventional method of knee replacement surgeries had good outcomes but 20% patient developed complication post-surgery. Furthermore, various advanced technology-based techniques majorly, Robotic, artificial intelligence have been recommended in this field. These novel technologies have shown increased efficacy and reduces complication ratio when compared to the traditional surgeries.

Objectives: This study aims to improve the efficacy of telerehabilitation approach.

Methodology: This study will be an experimental study. Subjects will be divided into two groups one experimental and one control group on the basis of inclusion /exclusion criteria. To calculate the sample space we will first pilot study. Outcome measures will be muscle activity through Surface Electromyography (SEMG), Range of Motion (ROM) and Knee Injury and Osteoarthritis Outcome Score (KOOS). Experimental group will perform exercise through telerehabilitation mode guided by SEMG and Control group will be perform exercises through home care.

Keywords*: Robot-assisted Total Knee Arthroplasty, Surface Electromyography (SEMG), Telerehabilitation,Telephysiotherapy.*

,.

TABLE OF CONTENTS

Certificate		i
Abstract		ii
Table of Contents		iii

S. No.	Contents	Page No.
I.	Introduction	1-2
(i)	Need of the Study	3
II.	Literature Review	4-5
III	Description of Broad Area	5
IV	Objectives of the Study	5
V	Methodology	6-7
VI	Expected Outcome of the Research	7
VII	References	8-12
	Plagiarism Report	

Introduction

Joint degenerative condition are the most leading cause of disability affecting, lack of appropriate treatment strategies caused increased medical cost burden and increases the risk of morbidity and mobility half of the population worldwide. Total knee arthroplasty (TKA) is considered worldwide as the most usual treatment approach for end-stage knee osteoarthritis (OA) including inflammatory arthritis, post fracture or trauma [1, 2].

Although conventional method of knee replacement surgeries had good outcomes but it has been seen that 20% case developed complication post-surgery[4].Robotic surgeries is one of the advanced technique driven towards better precision and early mobility in end stage of OA conditions. The trials have been largely condition in geriatric population where the results shown minimal complication and need minimal stay [5-8].

Studies has shown that Telerehabilitation (TR) interventions has similar clinical outcomes as compared to traditional modes of structured physiotherapy and home based intervention protocol. Additionally it has been proven that TR demonstrates improved functionality measure and effectiveness when compared to traditional method [9-12].

Efficacy of the surgical mode of intervention used in TKA patients has been supplemented when combine with principle of MDT Approach researches have highlighted that with the use of MDT patients demonstrate active participation and better compliance while performing physiotherapy regime. Furthermore they have also generated traffic guide light system which can effectively guide the patients to overcome the fear of performing self-exercise and to generate a patient centric protocol which can further increase the patient compliance towards physiotherapy regime [6].Combining MDT principles with advanced technologies like wearable sensors, step counter, hepatic feedback etc. can further improvise the effectiveness of the Telerehabilitation in TKA patients.

Recently the compliance of surgical intervention in end stage OA patients has been monitored with SEMG. It has been suggested that SEMG can get the measure of muscle activity while performing different exercises or activities. Furthermore provide visual feedback in various other medical conditions [16].

Moreover Telerehabilitation is one such medium through which both therapist and patient therapist and patients can connect with each other no matter how far they are residing. It also reduce waiting time and delays in appointments. During COVID pandemic, telerehabilitation emerged as one of the greatest asset for medical profession for providing necessary health care demand but as this technique is still emerging so there is lot of scope of improvement, researchers has found out few the challenges which need to be addressed are lack of contextualization, objectivity in monitoring &

assessment. However dearth of literature exemplifying the role of Telerehabilitation as an emerging tool towards e-health [14].

As we are advancing to the era of technology, newer and cheaper devices are coming in the market through which patients can monitor their health and because of today's hectic schedule telerehabilitation bring many advantages which are reduction of waiting and travelling time to the hospital or physiotherapy center and cost effective as compare to other method of treatment if we can combine it with other sensor based technology. Individual can use this technology according to availability of time and place. One of the study has tried to find out cost analysis of Telerehabilitation, which suggested that it has capability to reduce the costing at least 18% which can go up to 123% so by combining it with SEMG as we may can improve few of the limitation.

Need of the Study

a) There is lacuna in understanding the standardization and effectiveness of Telerehabilitation
b) Because of the busy schedule people has lesser time to travel and to wait for physiotherapy treatment, Telerehabilitation can act as an adjunct.
c) People residing in rural areas or living in different countries can also avail physiotherapy treatment through telerehabilitation.

Literature Review

a) One of the researches highlighted the utility of various advanced tools such as wearable devices and smartphone application used in TKA patients by David Constantinescu et al. 2022 this study suggest that commercially available smartphone apps and wearable devices can potentially improve remote assessment of physical activity and incentivize patient activity and engagement following TKA. Interventions such as step goals, app-based patient engagement platforms, and patient-specific benchmarks for recovery may improve effectiveness. However, there is paucity of evidence supporting the long-term efficacy and economic impact of this technology remains uncertain. Future research should focus on the economics of implementation, long-term outcomes, and optimization of compliance and accuracy when using these devices.
b) Study conducted by Seon, P in 2021 mentioned the effectiveness of Telerehabilitation in Physical Therapy suggest that telerehabilitation approach in physical therapy has shown positive impact as compared to traditional approach or better than no rehabilitation for different health conditions.

c) The challenges encountered in telerehabilitation have also been reviewed in one of the researches which highlighted that some of the factors in developing countries. Some of the factors like scarcity of knowledge and lack of skill required in e-health .Are some of the reasons is to why telerehabilitation is still underutilized .A systematic review conducted by Carl Froilan De Guzman et al. 2020 to find out major challenges in the emergence of Telerehabilitation in a Developing Country.

d) A systematic review and meta-analysis was done by Xia Wang et al. 2019 additionally telerehabilitation has shown reasonable level of efficacy in patients of TKA with respect to pain and functional mobility.

e) Another study done by Tousignant, I the year 2015 discussed the cost effectiveness and utility measures of telerehabilitation in post TKA patients. It further mentioned that telerehabilitation had significantly reduced the treatment cost up to 123% when compared to traditional home regimes.

Description of Broad Area

Surface Electromyography based Telerehabilitation in Total Knee Replacement.

Objectives of the Study

a) To evaluate the Range of Motion (ROM) in knee joint of the individual undergone Post Robot Assisted TKA after Telerehabilitation.

b) To evaluate the changes in the muscle activity of the quadriceps (Vastus Medialis , Vastus Lateralis) muscle and hamstring (Semitendinosus and Bicep Femoris) by using SEMG in individual undergone Post Robot Assisted TKA after Telerehabilitation.

c) To investigate the changes in Quality of life through Telerehabilitation in individuals undergone Post Robot Assisted TKA.

Methodology

STUDY DESIGN: Experimental study

TYPE of SAMPLING: Convenience sampling

VARIABLES:

a) Muscle activity through SEMG Quadriceps muscle (Vastus Medialis and Vastus Lateralis) and Hamstring (Semitendinosus and Biceps Femoris)

b) Flexion Range of Motion (App based /digital goniometer) [19]

c) KOOS

STUDY CENTER

Delhi NCR (patient staying more than 30 km from the treatment place)

INCLUSION CRITERIA

a) Patients underwent Robot Assisted Total Knee Arthroplasty Surgery after discharge from Hospital after 7 days
b) Post – Robot assisted TKA Knee active range of motion : flexion 80 degree
c) Individual able to walk with the help of walking aids
d) Aptitude to read, understand & should be familiar with the functioning of smartphone

EXCLUSION CRITERIA

An individual is excluded if they reported any

a) Any neuropathic sensiro motor , cognitive or praxic impairment
b) Concomitant medical condition which may influence the telerehabilitation approach;
c) Patient with any pathological complication (e.g. surgical wound infection, suspicion of DVT)

Sample Size

Will be calculated after pilot Study

Instruments Required: SEMG.

Expected Outcome of the Research

If there will be any pandemic situation arises in future which may can restricts the ability of the people moving outside than they will be well prepared to use technology as adjunct to improve their physical health. Secondly because of the time constraint some patients are not able undergo proper physiotherapy, technology mediated rehabilitation can be an alternative approach in which patient can take physical therapy according to their convenient time and place. It can also decrease the financial burden on health and patient compliance towards exercise.

References

1. Ghosh, A., & Chatterji, U. (2019). An evidence-based review of enhanced recovery after surgery in total knee replacement surgery. *Journal of perioperative practice, 29*(9), 281–290.

https://doi.org/10.1177/1750458918791121

2. Guo, E. W., Sayeed, Z., Padela, M. T., Qazi, M., Zekaj, M., Schaefer, P., & Darwiche, H. F. (2018). Improving Total Joint Replacement with Continuous Quality Improvement Methods and Tools. *The Orthopedic clinics of North America*, *49*(4), 397–403. https://doi.org/10.1016/j.ocl.2018.05.002
3. Sloan, M., Premkumar, A., & Sheth, N. P. (2018). Projected Volume of Primary Total Joint Arthroplasty in the U.S., 2014 to 2030. *The Journal of bone and joint surgery. American volume*, *100*(17), 1455–1460. https://doi.org/10.2106/JBJS.17.01617
4. Price, A. J., Alvand, A., Troelsen, A., Katz, J. N., Hooper, G., Gray, A., Carr, A., & Beard, D. (2018). Knee replacement. *Lancet (London, England)*, *392*(10158), 1672–1682. https://doi.org/10.1016/S0140-6736(18)32344-4
5. Dall'Oca, C., Ricci, M., Vecchini, E., Giannini, N., Lamberti, D., Tromponi, C., & Magnan, B. (2017). Evolution of TKA design. *Acta bio-medica : Atenei Parmensis*, *88*(2S), 17–31. https://doi.org/10.23750/abm.v88i2-S.6508
6. Carlton, L., Maccio, J. R., Maccio, J. G., Braga, A., Tomanio, E., & Belikov, A. (2018). The application of Mechanical Diagnosis and Therapy to the ankle-foot complex: a case series. *The Journal of manual & manipulative therapy*, *26*(3), 181–188. https://doi.org/10.1080/10669817.2018.1456028
7. Jaffe, W. L., Dundon, J. M., & Camus, T. (2018). Alignment and Balance Methods in Total Knee Arthroplasty. *The Journal of the American Academy of Orthopaedic Surgeons*, *26*(20), 709–716. https://doi.org/10.5435/JAAOS-D-16-00428
8. Bautista, M., Manrique, J., & Hozack, W. J. (2019). Robotics in Total Knee Arthroplasty. *The journal of knee surgery*, *32*(7), 600–606. https://doi.org/10.1055/s-0039-1681053
9. Kayani, B., Konan, S., Tahmassebi, J., Pietrzak, J. R. T., & Haddad, F. S. (2018). Robotic-arm assisted total knee arthroplasty is associated with improved early functional recovery and reduced time to hospital discharge compared with conventional jig-based total knee arthroplasty: a prospective cohort study. *The bone & joint journal*, *100-B*(7), 930–937. https://doi.org/10.1302/0301-620X.100B7.BJJ-2017-1449.R1
10. Zheng, G., & Nolte, L. P. (2015). Computer-Assisted Orthopedic Surgery: Current State and Future Perspective. *Frontiers in surgery*, *2*, 66. https://doi.org/10.3389/fsurg.2015.00066
11. Emmerson KB, Harding KE, Taylor NF. Providing exercise instructions using multimedia may improve adherence but not patient outcomes: A systematic review and meta-analysis. Clin Rehabil 2019 Apr;33(4):607-618. [doi: 10.1177/0269215518819706] [Medline: 30582358]

12. Kairy D, Lehoux P, Vincent C, Visintin M. A systematic review of clinical outcomes, clinical process, healthcare utilization and costs associated with telerehabilitation. Disabil Rehabil 2009;31(6):427-447. [doi: 10.1080/09638280802062553] [Medline: 18720118]
13. Block VAJ, Pitsch E, Tahir P, Cree BAC, Allen DD, Gelfand JM. Remote physical activity monitoring in neurological disease: A systematic review. PLoS One 2016;11(4):e0154335 [FREE Full text] [doi: 10.1371/journal.pone.0154335] [Medline: 27124611]
14. Cottrell MA, Galea OA, O'Leary SP, Hill AJ, Russell TG. Real-time telerehabilitation for the treatment of musculoskeletal conditions is effective and comparable to standard practice: A systematic review and meta-analysis. Clin Rehabil 2017 May;31(5):625-638. [doi: 10.1177/0269215516645148] [Medline: 27141087]
15. Exploring Barriers to Implementing Telerehabilitation from experiences of managers, policymakers, and providers of rehabilitation services in Iran: A Qualitative Study. *Medical journal of the Islamic Republic of Iran*, *36*, 157. https://doi.org/10.47176/mjiri.36.157 Rabanifar, N., Hoseini, M. A., & Abdi, K. (2022).
16. Rabanifar, N., Hoseini, M. A., & Abdi, K. (2022). Exploring Barriers to Implementing Telerehabilitation from experiences of managers, policymakers, and providers of rehabilitation services in Iran: A Qualitative Study. *Medical journal of the Islamic Republic of Iran*, *36*, 157. https://doi.org/10.47176/mjiri.36.157
17. Schwartz, M. S., & Andrasik, F. (Eds.). (2017). *Biofeedback: A practitioner's guide*. Guilford Publications.
18. Dursun, E., Dursun, N., & Alican, D. (2004). Effects of biofeedback treatment on gait in children with cerebral palsy. *Disability and rehabilitation*, *26*(2), 116–120. https://doi.org/10.1080/09638280310001629679 Tan KK, Narayanan AS, Choon-Huat Koh G, Kyaw KKH, Hoenig HM. Development of telerehabilitation application with designated consultation categories. J Rehabil Res Dev. 2014;51(9):1383-96.
19. Schmeler MR, Schein RM, McCue M, Betz K. Telerehabilitation clinical and vocational applications for assistive technology: research, opportunities, and challenges. Int J Telerehabil. 2009;1(1):59
20. Zampolini M, Todeschini E, Hermens H, Ilsbroukx S, Macellari V, Magni R, et al. Tele-rehabilitation: present and future. Ann Ist. 2008;44(2):125-134
21. Sung, J. H., Baek, S. H., Park, J. W., Rho, J. H., & Kim, B. J. (2023). Surface Electromyography-Driven Parameters for Representing Muscle Mass and Strength. *Sensors (Basel, Switzerland)*, *23*(12), 5490. https://doi.org/10.3390/s23125490 Exploring Barriers to Implementing Telerehabilitation from experiences of managers, policymakers, and

Manav Rachna International Institute of Research and Studies

(Deemed to be University)

School of Allied Health Sciences

Department of Physiotherapy

Consent Form

I, Dheeraj Kumar, PhD Scholar, 22-23/Ph.D/W/002, School of Allied health Science, Manav Rachna International Institute of Research & Studies is working on a Research Project, titled,

"Effectiveness of Telerehabilitation with Surface Electromyography on Muscle Function and Quality of Life in Robot-assisted Total Knee Arthroplasty Individuals"

Purpose of the Study

The purpose of the study is to find effectiveness of Telerehabilitation approach combining it with Surface Electromyography, the study will find out the role of Surface Electromyography in improving the limitation of Telerehabilitation approach for Post robot assisted Total Knee Arthroplasty patients.

Duration of Participation

The estimated duration of each subject participation is about 16 Days.

Explanation of Procedure

If you decide to participate, you will be asked to, provide consent for the collection and analysis of your data.

Potential Benefit of Participation

While specific benefits cannot be guaranteed, potential benefits of participating in this research is that it will provide better technology based telerehabilitation treatment options for robot assisted Total Knee Arthroplasty.

Compensation

Financial Considerations

There are no special fees for participating in this study. However, the cost for participating will be borne by the Principal Investigator (PI) of the project. This includes the structured exercise program and training of technology, which will be instructed and sessions will be free of cost.

Voluntary Nature of the Study

The participation of the patient in the study is purely voluntary in nature.

Right to withdraw

Participants are free to withdraw their consent to participate in this study anytime. Refusal to participate or withdrawal will not affect your future care and will involve no penalty to you.

In the event, new information becomes available that may affect your willingness to participate in this study, this information will be given to you so that you can make an informed decision about whether or not to continue your participation.

Assurance of Anonymity and Confidentiality:

The identity of the patient and data collected will remain absolutely confidential and anonymous. Furthermore, only averaged data will be shared and/ or published, thus maintaining anonymity of the patient.

Potential Risks or Discomforts

The potential risks associated with participating in this study are no or minimal. However, some individuals may experience temporary muscle soreness or fatigue due to engaging in the exercise and therapy sessions. Every effort will be made to minimize these risks by evaluation of preliminary information relating to your health and fitness and by careful observations during the procedure.

Contact Information:

Dheeraj Kumar

Ph.D. Scholar,

G-447/20, Bhim Singh Complex, Badarpur Border,

New Delhi

Contact No: +91 8527144753

(Aadhar No: 827799190360)

Declaration

-I confirm that I have read and understood the information and purpose of the study.

-I have been informed about the quantity of data to be taken and the use that will be made of the data.

-I agree to the data being used for immediate routine measurements, and for relevant results to be provided to me.

-I agree that my data may be stored for future research. This is on the understanding that the investigations will be for medical research only and my results will be kept confidential.

-I have read this form and the research study has been explained to me.

-I have been given the opportunity to ask questions and my questions have been answered to my satisfaction.

-If I have additional questions, I have been told who to contact

-I agree to participate in the research study described above. I can ask for a copy of this consent form after I sign it if I want to.

Participant's Name & Signature:

Participant Aadhar card No. / PAN No :

Please attach the copy of Aadhar card

Name of the researcher & Signature:

Ph.D. Scholar,

G-447/20, Bhim Singh Complex, Badarpur Border, New Delhi

Contact No: +91 8527144753

(Aadhar No: 827799190360)

Name of the Supervisor & Signature:

Dr. Jasmine Kaur Chawla

Associate Professor

Department of Physiotherapy

School of Allied Health Sciences

Manav Rachna International Institute of Physiotherapy

Faridabad, Haryana

Contact No: 9888263685

मानव रचना अंतर्राष्ट्रीय अनुसंधान एवं अध्ययन संस्था

(मानित विश्वविद्यालय)

स्कूल ऑफ एलाइड हेल्थ साइंस

भौतिकचिकित्सा विभाग

सहमति पत्र

मैं, धीरज कुमार, पीएच.डी. छात्र, 22-23/पीएचडी/डब्ल्यू/002, स्कूल ऑफ एलाइड हेल्थ साइंस, मानव संसाधन

रचना अंतर्राष्ट्रीय अनुसंधान एवं अध्ययन संस्थान एक अनुसंधान परियोजना पर कार्यरत है,

शीर्षक,

"रोबोट-सहायता प्राप्त कुल घुटने के आर्थ्रोप्लास्टी व्यक्तियों में मांसपेशी कार्य और जीवन की गुणवत्ता पर सतह इलेक्ट्रोमायोग्राफी के साथ टेलीरिहैबिलिटेशन की प्रभावशीलता"

इस अध्ययन का लक्ष्य

अध्ययन का उद्देश्य टेलीरिहैबिलिटेशन दृष्टिकोण को इलेक्ट्रोमायोग्राफी के साथ संयोजित करके इसकी प्रभावशीलता का मूल्यांकन करना है। यह अध्ययन पोस्ट रोबोट-सहायता प्राप्त कुल घुटने के आर्थ्रोप्लास्टी रोगियों के लिए टेलीरिहैबिलिटेशन दृष्टिकोण की सीमाओं को सुधारने में इलेक्ट्रोमायोग्राफी की भूमिका का विश्लेषण करेगा।

भागीदारीकीअवधि

प्रत्येक विषय में भागीदारी की अपेक्षित अवधि लगभग 16 दिन है।

प्रक्रिया का विवरण

यदि आप भाग लेने का निर्णय लेते हैं, तो आपसे संग्रह के लिए सहमति देने का अनुरोध किया जाएगा।

आपके डेटा का विश्लेषण किया गया।

भागीदारी के संभावित लाभ

यद्यपि विशिष्ट लाभों की गारंटी नहीं दी जा सकती, फिर भी इसमें भाग लेने के संभावित लाभ विद्यमान हैं।

शोध से यह भी स्पष्ट हुआ है कि इससे टीकेए के लिए उन्नत प्रौद्योगिकी आधारित टेली-रिहैबिलिटेशन उपचार विकल्प उपलब्ध होंगे।

मुआवज़ा

वित्तीय विमर्श

इस अध्ययन में भाग लेने के लिए कोई विशेष शुल्क नहीं है। हालाँकि, भागीदारी की लागत

परियोजना के प्रधान अन्वेषक (पी.आई.) द्वारा वहन किया जाएगा। इसमें संरचित व्यय शामिल है।

व्यायाम कार्यक्रम और प्रौद्योगिकी का प्रशिक्षण, जिसमें शिक्षा और सत्र निःशुल्क प्रदान किए जाएंगे।

अध्ययन कीस्वैच्छिक विशेषता

अध्ययन में रोगियों की भागीदारी पूरी तरह से स्वैच्छिक है।

वापसी काअधिकार

प्रतिभागी किसी भी समय इस अध्ययन में भाग लेने के लिए अपनी सहमति वापस लेने के लिए स्वतंत्र हैं।

भाग लेने या वापस लेने से आपकी भविष्य की देखभाल पर कोई प्रभाव नहीं पड़ेगा और आपको कोई जुर्माना नहीं देना होगा।

ऐसी स्थिति में, कोई नई जानकारी उपलब्ध होती है जो आपकी इच्छाओं को प्रभावित कर सकती है।

इस अध्ययन में भाग लेने के लिए, आपको यह जानकारी प्रदान की जाएगी ताकि आप अपने निर्णय को सुचारू रूप से ले सकें।

अपनी भागीदारी जारी रखने या समाप्त करने के संबंध में सूचित निर्णय लें।

गुमनामी और गोपनीयता का वचन

रोगी की पहचान और एकत्रित डेटा पूरी तरह से गोपनीय रहेगा और

गुमनाम। इसके अतिरिक्त, केवल औसत डेटा साझा और/या प्रकाशित किया जाएगा, इस प्रकार

रोगी की पहचान को गुप्त रखना।

संभावित जोखिम या कठिनाइयाँ

इस अध्ययन में भाग लेने से जुड़े संभावित ज़ोखिम नगण्य या न्यूनतम हैं। हालांकि,

कुछ व्यक्तियों को व्यायाम के परिणामस्वरूप अस्थायी रूप से मांसपेशियों में दर्द या थकान का अनुभव हो सकता है।

व्यायाम और चिकित्सा सत्र। इन जोखिमों को कम करने के लिए सभी संभावित प्रयास किए जाएंगे।

आपके स्वास्थ्य और फिटनेस से संबंधित प्रारंभिक जानकारी का मूल्यांकन और ध्यानपूर्वक

प्रक्रिया के दौरान निरीक्षण।

संपर्क विवरण:

धीरज कुमार

पीएच.डी. शोधार्थी,

जी-447/20, भीम सिंह कॉम्प्लेक्स, बदरपुर सीमा,

नई दिल्ली

संपर्क संख्या: +91 8527144753

(Aadhar No: 827799190360)

घोषणा

-मैं पुष्टि करता हूँ कि मैंने अध्ययन की जानकारी और उद्देश्य को पढ़ लिया है और उसे समझ लिया है।

मुझे लिए जाने वाले डेटा की मात्रा और उसके उपयोग के संबंध में जानकारी प्रदान की गई है।

आंकड़ा।

मैं तात्कालिक नियमित मापन और प्रासंगिक परिणामों के लिए उपयोग किए जा रहे डेटा से सहमत हूं।

मुझे प्रदान किया जाएगा।

-मैं सहमत हूँ कि मेरा डेटा भविष्य के अनुसंधान के लिए संग्रहित किया जा सकता है। यह इस समझ पर है कि

मेरी जांच केवल चिकित्सा अनुसंधान के उद्देश्य से की जाएगी और मेरे परिणामों को गोपनीय रखा जाएगा।

-मैंने इस फॉर्म को पढ़ लिया है और मुझे शोध अध्ययन के विषय में जानकारी दी गई है।

मुझे प्रश्न पूछने का अवसर प्रदान किया गया है और मेरे प्रश्नों के उत्तर दिए गए हैं।

मेरी संतोष.

-यदि मेरे पास अतिरिक्त प्रश्न हों, तो मुझे सूचित किया गया है कि किससे संपर्क करना है।

-मैं उपरोक्त वर्णित शोध अध्ययन में भाग लेने के लिए सहमत हूँ। मैं इसकी एक प्रति मांग सकता हूँ।

यदि मैं चाहूँ तो सहमति पत्र पर हस्ताक्षर करने के पश्चात ही हस्ताक्षर कर सकता हूँ।

प्रतिभागी का नाम एवं हस्ताक्षर :

प्रतिभागी आधार कार्ड संख्या / पैन संख्या :

कृपया आधार कार्ड की एक प्रति संलग्न करें।

शोधकर्ता का नाम और हस्ताक्षर:

पीएच.डी. शोधार्थी,

जी-447/20, भीम सिंह कॉम्प्लेक्स, बदरपुर सीमा,

नई दिल्ली

संपर्क संख्या: +91 8527144753

(Aadhar No: 827799190360)

पर्यवेक्षक का नाम और हस्ताक्षर:

डॉ. जैस्मीन कौर चावला

सहायक प्राध्यापक

भौतिकचिकित्सा विभाग

संबंधित स्वास्थ्य विज्ञान विद्यालय

मानव रचना अंतर्राष्ट्रीय संस्थान फिजियोथेरेपी

फरीदाबाद, हरियाणा

संपर्क संख्या: 9888263685

Data Collection Form

Name: **Age/Sex:**

Contact No.:-

Address:-

Socio/Economic Status:

C/C:

Present History of Patient:

Past History of Patient:

Medical/Surgical History:

a) Are you suffering from Diabetes from last one year? Yes/No

c) Taken any NSAID for knee in last one year? Yes/No

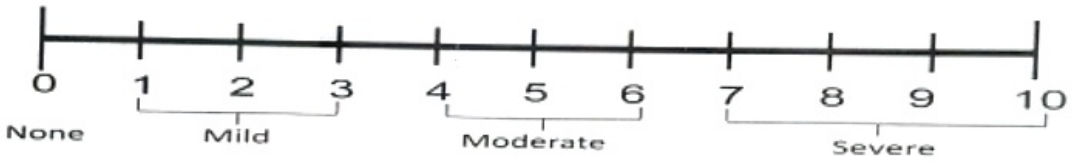
d) Are you suffering from Hypertension from last one year? Yes/No

Pain History

Type of Pain: **Site of Pain:**

Side Pain: **Nature /Behavior of Pain:**

NPRS (Numeric Pain Scale):

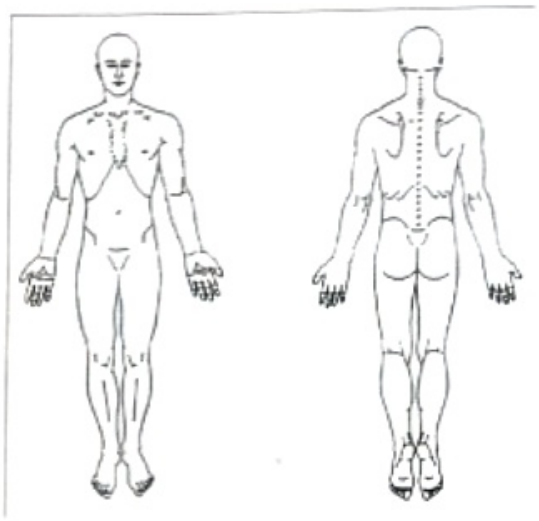


a)Type of Surgery:

b) Date of surgery:

c) Which side of knee operated? R/L

Body Chart



Observation:

a) Posture:

b) Swelling:

c) Gait:

d) Deformity:

Examination

BMI:

Muscle Spasm: Present/Absent

Tenderness:Present/Absent

Oedema:

a) Grade1:

b) Grade2:

c) Grade 3:

d) Grade 4:

End Feel: Soft/Firm/Hard

Muscle Length:

a) Quadriceps:

b) Calf:

b)Hamstring:

Muscle Girth:

a) Quadriceps: b)Hamstring:

PROM of Knee:

PROM	Right	Left
Flexion		
Extension		

AROM:

PROM	Right	Left
Flexion		
Extension		

MMT:

PROM	Right	Left
Flexors		
Extensors		

Resisted Isometric Contraction (RIC): Tone:

Reflex:

Standing Balance:

Open Eyes	
Closed Eyes	
Narrow Base of Support(Open Eyes)	
Narrow Base of Support (Closed Eyes)	
Tandem Stance static	
Tandem Stance Dynamic	
Tandem Walking	

Investigation:

Diagnosis:

Knee Injury and Osteoarthritis Outcome Score (KOOS)

Source: Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure. *J Orthop Sports Phys Ther.* 1998 Aug;28(2):88-96.

The Knee Injury and Osteoarthritis Outcome Score (KOOS) is a questionnaire designed to assess short and long-term patient-relevant outcomes following knee injury. The KOOS is self-administered and assesses five outcomes: pain, symptoms, activities of daily living, sport and recreation function, and knee-related quality of life. The KOOS meets basic criteria of outcome measures and can be used to evaluate the course of knee injury and treatment outcome. KOOS is patient-administered, the format is user-friendly and it takes about 10 minutes to fill out.

Scoring instructions

The KOOS's five patient-relevant dimensions are scored separately: Pain (nine items); Symptoms (seven items); ADL Function (17 items); Sport and Recreation Function (five items); Quality of Life (four items). A Likert scale is used and all items have five possible answer options scored from 0 (No problems) to 4 (Extreme problems) and each of the five scores is calculated as the sum of the items included.

Interpretation of scores

Scores are transformed to a 0–100 scale, with zero representing extreme knee problems and 100 representing no knee problems as common in orthopaedic scales and generic measures. Scores between 0 and 100 represent the percentage of total possible score achieved.

Knee Injury and Osteoarthritis Outcome Score (KOOS)

Pain

P1 How often is your knee painful?	☐ Never	☐ Monthly	☐ Weekly	☐ Daily	☐ Always

What degree of pain have you experienced the last week when...?

P2 Twisting/pivoting on your knee	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
P3 Straightening knee fully	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
P4 Bending knee fully	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
P5 Walking on flat surface	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
P6 Going up or down stairs	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
P7 At night while in bed	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
P8 Sitting or lying	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
P9 Standing upright	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme

Symptoms

Sy1 How severe is your knee stiffness after first wakening in the morning?	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
Sy2 How severe is your knee stiffness after sitting, lying, or resting later in the day?	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
Sy3 Do you have swelling in your knee?	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	☐ Always
Sy4 Do you feel grinding, hear clicking or any other type of noise when your knee moves?	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	☐ Always
Sy5 Does your knee catch or hang up when moving?	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	☐ Always
Sy6 Can you straighten your knee fully?	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Sy7 Can you bend your knee fully?	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never

Activities of daily living

What difficulty have you experienced the last week...?

A1 Descending	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A2 Ascending stairs	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A3 Rising from sitting	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A4 Standing	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A5 Bending to floor/picking up an object	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A6 Walking on flat surface	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A7 Getting in/out of car	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A8 Going shopping	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A9 Putting on socks/stockings	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A10 Rising from bed	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A11 Taking off socks/stockings	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A12 Lying in bed (turning over, maintaining knee position)	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A13 Getting in/out of bath	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A14 Sitting	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A15 Getting on/off toilet	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A16 Heavy domestic duties (shovelling, scrubbing floors, etc)	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
A17 Light domestic duties (cooking, dusting, etc)	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme

Sport and recreation function

What difficulty have you experienced the last week...?

Sp1 Squatting	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
Sp2 Running	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
Sp3 Jumping	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
Sp4 Turning/twisting on your injured knee	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme
Sp5 Kneeling	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme

Knee-related quality of life

Q1 How often are you aware of your knee problems?	☐ Never	☐ Monthly	☐ Weekly	☐ Daily	☐ Always
Q2 Have you modified your lifestyle to avoid potentially damaging activities to your knee?	☐ Not at all	☐ Mildly	☐ Moderately	☐ Severely	☐ Totally
Q3 How troubled are you with lack of confidence in your knee?	☐ Not at all	☐ Mildly	☐ Moderately	☐ Severely	☐ Totally
Q4 In general, how much difficulty do you have with your knee?	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Extreme

MANAV RACHNA
vidyayatan ishan

Dr. O.P. Bhalla Central Library
Manav Rachna International Institute of Research and Studies
(A deemed-to-be-university under section 3 of UGC Act 1956)

SIMILARITY VERIFICATION CERTIFICATE

Title: EFFECTIVENESS of TELEREHABILITATION WITH SURFACE ELECTROMYOGRAPHY ON MUSCLE FUNCTION AND QUALITY OF LIFE IN ROBOT-assisted TOTAL KNEE ARTHROPLASTY INDIVIDUALS

Researcher: Dheeraj Kumar

Registration Number: 22-231/Ph.D/W/002

Supervisor: Dr. Jasmine Kaur Chawla

Department: of PHYSIOTHERAPY

This is to certify that the above mentioned Short Synopsis/Thesis was scanned for similarity index through Turnitin Software on 29/1/25 with submission ID 2618:80432408 and the similarity index was found to be 8 %. The complete report running into 9 Pages, 2394 Word count with File Size 159 KB is being forwarded to the Research Supervisor/DRC/DRB for review.

Date:

Rajesh Kumar
Dr. Rajesh Kumar
University Librarian
Dr. O.P. Bhalla Central Library
Manav Rachna International
Institute of Research & Studies
Faridabad

The complete report of the above Short Synopsis/Thesis has been reviewed and the similarity index is below the accepted norms as per the University Grants Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations 2018. The Short Synopsis/Thesis may be considered for further processing

Research Scholar

Research Supervisor

Dheeraj Kumar

Effectiveness of Telerehabilitation with Surface Electromyography on Muscle Function and Quality of

Manav Rachna International Institute of Research and Studies

Document Details

Submission ID
trn:oid:::3618:80432408

Submission Date
an 29, 2025, 12:23 PM GMT+5:30

Download Date
an 29, 2025, 12:24 PM GMT+5:30

File Name
ffectiveness of Telerehabilitation with Surface Electromyography on Muscle Function and Qua....docx

File Size
59.0 KB

9 Pages

2,394 Words

14,964 Characters

Dr. Rajesh Kumar
University Librarian
Dr. O.P. Bhalla Central Library
Manav Rachna International
Institute of Research & Studies
Faridabad

Excluding matches
less than 14 words

iThenticate Page 1 of 12 - Cover Page Submission ID trn:oid:::3618:80432408

8% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography
- Quoted Text
- Small Matches (less than 12 words)

Match Groups

- 4 Not Cited or Quoted 8%
  Matches with neither in-text citation nor quotation marks
- 0 Missing Quotations 0%
  Matches that are still very similar to source material
- 0 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

8% Internet sources
7% Publications
0% Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

No suspicious text manipulations found.

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

Dr. Rajesh Kumar
University Librarian
Dr. O.P. Bhalla Central Library
Manav Rachna International
Institute of Research & Studies
Faridabad

iThenticate Page 2 of 12 - Integrity Overview Submission ID trn:oid:::3618:80432408

Match Groups

- 4 Not Cited or Quoted 8%
  Matches with neither in-text citation nor quotation marks
- 0 Missing Quotations 0%
  Matches that are still very similar to source material
- 0 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

8% Internet sources
7% Publications
0% Submitted works (Student Papers)

Top Sources

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Internet www.ncbi.nlm.nih.gov	5%
2	Internet shodh.inflibnet.ac.in:8080	1%
3	Internet link.springer.com	1%
4	Internet ichgcp.net	<1%

Rajesh Kumar
Dr. Rajesh Kumar
University Librarian
Dr. O.P. Bhalla Central Library
Manav Rachna International
Institute of Research & Studies
Faridabad

Excluding matches
less than 10 words

iThenticate Page 3 of 12 - Integrity Overview Submission ID trn:oid:::3618:80432408

Effectiveness of Telerehabilitation with Surface Electromyography on Muscle Function and Quality of Life in Robot-assisted Total Knee Arthroplasty Individuals

SHORT SYNOPSIS

by

Dheeraj Kumar

22-23/Ph.D/W/002

Under the supervision of

Supervisor

(Dr.) Jasmine Kaur Chawla

Associate Professor,

Department of Physiotherapy

School OF Allied Health Science

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

SECTOR-43, SURAJKUND –DELHI ROAD, FARIDABAD – 121001

ABSTRACT

Background/Introduction: Total knee arthroplasty (TKA) is the well-known solution for chronic degenerative and post traumatic cases. Although conventional method of knee replacement surgeries had good outcomes but 20% patient developed complication post-surgery. Furthermore, various advanced technology-based techniques majorly, Robotic, artificial intelligence have been recommended in this field. These novel technologies have shown increased efficacy and reduces complication ratio when compared to the traditional surgeries.

Objectives: This study aims to improve the efficacy of telerehabilitation approach.